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ABSTRACT

Intended for use in elementary and high school education, this Web site includes a teacher's guide and three lesson plans. The site contains images of museum specimens, scientific drawings, and field photos of the plant and animal species observed by Meriwether Lewis and William Clark, along with journal excerpts, historical notes, and references for many of these examples as well as the date and location of observation. The site may be searched by species groups (mammals, plants, birds, fish, reptiles, amphibians), by location (interactive map, the collection, or search), or by date (interactive map-timeline, or the collection). The "Resources" section includes suggestions for teachers as well as links to sites to Web sites with additional information about the plant and animal species. The teacher's guide provides ideas to get students immersed in U.S. history, geography, social studies, and the natural world at the beginning of the 19th as well as the 21st century. It contains ideas (by Susan Metcalfe and Robert Costello) for grades 3-5, grades 6-8, and grades 9-12. The lesson plan, "Beginning Botany with Camas" (Gail McEachron), specifies grade level, purpose, and previous knowledge; cites objectives; provides a detailed procedure; offers background information; addresses standards; and lists references. The lesson plans, "Clark's Nutcracker" and "Grizzly Survival" (Gail McEachron), present background information before following the same procedure as the first lesson. (BT)

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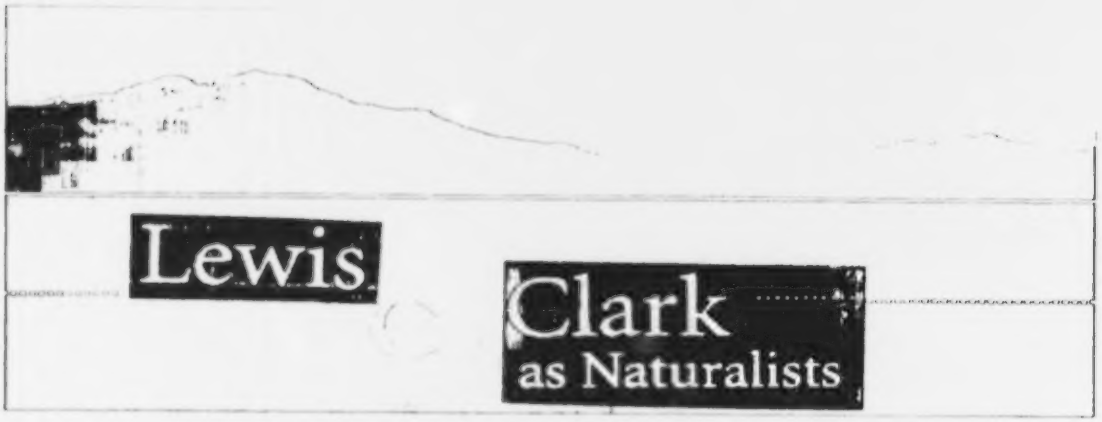

Smithsonian Institution

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Lewis and Clark as Naturalists

More Information About this Site

(www.mnh.si.edu/lewisandclark)

Intended Users

This site has been designed to be particularly useful for elementary and high school education and includes a Teachers' Guide and several lesson plans, but the content should be interesting and informative to the general public, whether in North America or abroad.

Content

The site contains images of museum specimens, scientific drawings, and field photos of the plant and animal species observed and described by Lewis and Clark, along with journal excerpts, historical nôtes, and references for many of these examples as well as the date and location of observation

The scholarly information presented here is derived from published works of experts in their fields (history, zoology, botany). Information found here is but a small portion of that available in the source documents that were used (see References below).

The site may be searched by species groups (mammals, plants, birds, fish, reptiles, amphibians under "The Collection" or "Search"), by location ("Interactive Map", "The Collection", or "Search"), or by date ("Interactive Map - Timeline", or "The Collection").

The "Resources" area include suggestions for teachers as well as links to sites to web sites with additional information about the plant and animal species.

Technical Requirements

This site is best viewed with the latest browsers to enable full interactivity (we recommend Internet Explorer 6.0 or Netscape 7.0 but versions as low as Internet Explorer 5.0 or Netscape 4.7 should be able to offer most, if not all, of the features); the browser should be able to use Java Script. There is an interactive map that works best with Flash©, but a non-Flash version is available. There are QuickTime© images of many of the zoological specimens, but the features of these specimens are also apparent in the still images available without QuickTime©. We have tried to keep file size small so that you might have an equally rewarding experience whether you are using a telephone modem or a broad-band connection. The images have been scaled for screens set at a resolution of at least 800 by 600 pixels. Most images are displayed as thumbnails and as pop-ups in a separate screen. For full enjoyment, you should disable any program that prevents pop-up screens.

Where Do the Specimens Come From?

At two times during the trip (from Fort Mandan in April 1805 and from St. Louis in September 1806), the collected specimens were indexed and sent to President Jefferson. Unfortunately, some specimens that had been cached at Great Falls for pick up on the return trip were lost or ruined during the winter of 1805-06 when the Missouri flooded. President Jefferson transferred the zoological specimens to the Peale Museum and the botanical specimens to the American Philosophical Society, both in Philadelphia. Scientists studied the specimens carefully over a number of years and published their findings and drawings. Over time other specimens from some of the same areas were collected by other explorers or scientists and some of these may have been perceived as "better" and introduced into the Lewis and Clark collection. To the extent that a more recent specimen is not exactly the same as the original, or that multiple specimens have been mounted together and actually represent different varieties or sub-species, a considerable amount of detective work is necessary to determine which specimen is the one collected by the Corps and what is the correct scientific designation. These problems are particularly true for the botanical specimens and the comments by Reveal et al.[1] are instructive as to the complexity of the task. A significant portion of the botanical collection went to Europe with an eminent botanist who was illustrating and describing some species. Most, if not all, of these specimens eventually returned, fell into private hands, and then were given to the Academy of Natural Sciences in Philadelphia where they are kept in a special room today.

The zoological collection remained in Philadelphia, but over time there was some dispersion to other museums and collections with the result that some were destroyed in a fire and others were lost with the result that none remain today.

The actual specimens presented on this web site were *NOT* collected by Lewis and Clark. The examples that are presented here are housed in the collections of the National Museum of Natural History, Smithsonian Institution. For the plants, we have made every effort to present examples that are the same species and subspecies as the Lewis and Clark specimens, and where more than one example exists in the Museum's collections, we selected the one that came from an area close to the route of the Corps of Discovery. In some instances, labels on the original Lewis and Clark specimens were not attached or had incomplete information about date or location. In these cases, different published references have made assumptions about locality and/or dates or, by comparing the identified species with either the seasonal stage of development or current geographic distribution, or deduced according to the Corps' known itinerary. We have made an effort to note where these assumptions or deductions have been included.

For the animals, we found using subspecies designations to be confusing and too often incorrect to merit their use. Therefore, we use only species, which coincidentally makes

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[1] Reveal, James L., Moulton, Gary E., and Schuyler, Alfred E., "The Lewis and Clark collections of vascular plants: Names, types, and comments", *Proceedings of the Academy of Natural Sciences of Philadelphia, 149*, 1-64, 1999

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pretty clear that many species that some authors have attributed to Lewis and Clark were not new to science, however, their observations extended the known range for the species.

Nomenclature for Species

All of the specimens are listed alphabetically by their current scientific name. Common names are included, but the names chosen may be only one of several names by which a plant or animal is known.

Several members of the Corps kept journals during the trip. These journals have subsequently been published (and re-published) either as edited manuscripts, or relatively faithful (in spelling, grammar, punctuation) versions to the author's original notes.

Localities

Localities were chosen to be at or near where specimens were collected, significant observations were made, or where the corps camped for some period of time. At several points, the eastbound and westbound routes were coincident and The Corps camped at sites that they had used previously. At Fort Mandan, Fort Clatsop, Great Falls, Canoe Camp, Camp Chopunnish, and Travelers Rest, the Corps remained for days to months. They used these opportunities to acquire enough provisions while they were still in an area with abundant game (for food, clothing, shoes, shelter). At Forts Mandan and Clatsop, they were waiting for spring thaws to allow them to move over the mountains. At Great Falls they were involved in preparation and execution of a difficult portage around the Great Falls of the Missouri. At Camp Chopunnish they waited for snows to melt and they made the necessary preparations for the group to traverse Rocky Mountains; at Travelers Rest, they were preparing to split into smaller exploratory teams to finally come together near the junction of the Yellowstone and Missouri Rivers before the final leg to St. Louis.

References

Among the resources upon which the editors relied heavily were:

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- Smithsonian's National Museum of Natural History on-line database Mammal Species of the World, http://www.nmnh.si.edu/msw
- Rosenberger, A. L., Taxonomy - What's in a name? http://www.visionlearning.com/library/science/biology-2/BIO2.1-taxonomy.htm

Editorial Credit

This web site was developed by staff of the Smithsonian Institution's National Museum of Natural History in commemoration of the bicentennial of Lewis and Clark's transcontinental expedition with their Corps of Discovery. Robert Costello, Distance Learning Program Manager has been the lead architect for this site and is also editor for the zoological species; George F. Russell, Collections Manager, US National Herbarium, is editor for the botanical information. Working together and with the contractor for creating the code for the web site, they established the features of the site as you see it today. The site is still a work in progress. While the details for some species are relatively complete, we are still collecting the images, journal entries, and ancillary information for others.

Most of the images on this site are property of the Smithsonian Institution's National Museum of Natural History. Some examples, however, are the property of individuals not affiliated with the museum and are used with permission as designated. In all cases, the source of the image has been identified.

February 27, 2003

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We know teachers never lack for innovative ideas and that you'll find fabulous ways to use this website for your curriculum, nevertheless, some of the Smithsonian Institution's educators couldn't help but come up with a few ideas. We hope you find these ideas useful as ways to get students immersed in U.S. history, geography, social studies, and the natural world at the beginning of the 19th as well as the 21st century.

Grades 3-5

I.a. The Collector and the Collected

Lewis and Clark collected many examples of the species they observed. Have your students look at examples from the Botany collection, such as the **bigleaf maple** (*Acer macrophyllum*). Let them study and compare the two collection sheets with the two photos of living bigleaf maple. From this study, see if the students can identify the parts of the plant that needed to be gathered. Lastly, assign pairs of students a single plant species to collect and preserve, much as a herbarium would. Their notes should indicate as much information on where it was found as possible, and the date. Students may want to record other types of plants at the location, or any factors that would effect the growth and vitality of the plant, such as the availability of sunlight, or nearby geographic or manmade features, like streams, roads, and buildings.

I.b. A Method for Seeing

Encourage your students to see themselves as nature detectives by keeping a journal of observations on one or two animals, quietly spying on their subject. They should focus on something manageable such as a family of bird or two, or a squirrel they can see from their window at home. Students should draw a picture in their journals, and record time of day, weather, and temperature, and then try to describe behavior in complete sentences. Giving them specific things to observe will improve their field notes: feeding behavior, response to other birds, response to a threat, kind of food preferred, and preferred footing, such as ground or tree, and limb or trunk. Does the animal prefer to be in a group or be alone? Where does the animal go when reacting to a threat? What kind of food does the animal seem to like? What kinds of things make the animal change behaviors (loud noise, big truck, another animal, etc.)? Developing a table or chart to organize categories of behavior can make recording them much more effective.

Grades 6-8

II.a. A Reason for Seeing

A lost journal of L&C has been discovered! The journal was found in box of old books being sold at a garage sale in South Dakota. It is bound in the same red Moroccan leather and tied with an old string. The small book tells us that Lewis took a week-long journey ...your students need to write the lost journal entries about this trip. Have students make a list of the kind of information included in the journals--natural observations, meeting of native groups, hunting animals for food, listing species, etc. Students can try to capture the curiosity of seeing an animal for the very fist time by making a detailed description of a plant or animal. Can they discover plants and animals in the neighborhood that they never noticed before? Can find a new sighting each day for a few days? Keep in mind the best pure descriptions do not contain explanations.

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II.b. Form, Function, and Adaptation

Having students answer a specific question using this website is a good way to encourage analysis, collaboration, and problem solving. Your students can create their own understanding and construct a project to demonstrate that understanding. The Smithsonian Institution's Lewis and Clark as Naturalists website has lots of images of animals appearing in their natural settings. Students can use these field shots to create a PowerPoint presentation or a simple website that answers a question such as "What are some of the adaptations Lewis and Clark saw that help animals survive the winter?" Students should work in pairs or small groups to help them solve the problem together. To save a picture for use in another medium, students simply right click on their mouse and select Copy. They then right click and Paste the image into a word processing program, a presentation program or a web design program.

II.c. What's Hot and What's Not

Can your students work out several reasons why Lewis and Clark needed a good system of recording information? Have your students look at the image of x plant (suggested species?) and identify the parts of the plant that needed to be gathered kind of information that had to be recorded. Read the journal entry describing the plant. Lastly, assign pairs of students a single plant species to collect and preserve. Their notes should indicate where it was found, date, and habitat. Have students explore the role each structure serves for the plant. Explore the systems and structures plants have. (roots for water and mineral absorption, stems for transportation, leaves for transforming light into energy, seeds for propagation…)

II.d. Wording

All students will notice that the grammar, punctuation and spelling in the journals is not correct according to today's standards and they typically enjoy correcting the mistakes of adults. Copy and paste some long journal entries into a word processing document, have students rewrite excerpts correctly.

Grades 9-12

III.a. Mapping Biodiversity and Biogeography

Lewis and Clark traveled thousands of miles during which time they would see a species for a long time and then gradually not see it anymore. This can tell your students important information about a species' distribution and habitat requirements. In this exercise, students create a single map showing the trail of the Corps of Discovery. The map should include major geographic features such as rivers and mountains, the major ecoregions the expedition passed through, and the distribution of five different species.

Using a textbook or animal encyclopedia, have students read about the food and habitat preferences of the Stellar's Jay, Clark's Nutcracker, Magpie, Ground Squirrels, and the Condor. For mammals, we shamelessly recommend using the Smithsonian Book of North American Mammals, or the Smithsonian's web site on North American Mammals (http://web6.si.edu/np_mammals).

Using a spreadsheet program, have students record every instance when Lewis and Clark observed these species. The data should be recorded in two columns titled "Species Name" and "Location." Students then need to create a map where the species was found. If the map function is not in your program, you can give your students a

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worksheet map of the US that shows major geographic features, letting them add the trail. Colored pencils work well. Different species can be represented by different colors and shapes, e.g., solid cirles, triangles, squares, etc. These should appear as points along the trail.

Finally, using a map showing United States ecoregions--The World Wildlife Fund map http://www.nationalgeographic.com/wildworld/terrestrial.html and http://www.worldwildlife.org/ecoregions/ are excellent resources--have students map out the distribution of the species onto their worksheet map. These regions should look like large, irregular shapes that the trail bisects.

III.a.i Extension to Mapping Biodiversity and Biogeography

Compare a single species historic distribution with its present day one. We say "historic" rather than "at the time of Lewis and Clark," as reasonably accurate records are scarce to nonexistent from two centuries ago. Keep in mind that not all species' distributions have contracted, the coyote being one example. Use contemporary maps showing North American (and beyond) animal distribution, such as those found in the field guide, Mammals of North America, by Roland W. Kays and Don E. Wilson, Princeton University Press, 2002. A few suggested species are elk, brown bear, wolf, coyote, puma, condor, and the various grouses.

III.b. Homologs, Analogs, and Natural Variation

At the time of the Corps of Discovery, Darwin's big book theory on the evolution of species was more than a half-century into the future. Lewis and Clark understood species in an entirely different way than people did after Darwin. To these men, species were fixed, unchanging entities. Variations within species were often regarded as imperfections resulting from the contingencies of growth, development, and the environment. Animals that looked alike were not imagined to share a common ancestor.

Yet they often remark that a new animal reminds them of a familiar animal and it is common to explain something new in terms of something old. Have your students read some of the journal accounts of species, such as pronghorn, brown bear, bighorn sheep, mountain goat, Clark's grebe, etc., and observe how they struggle with categorization.

III.c. Form, Function, and Adaptation

Select Quicktime VR images of skulls from different families of bird (e.g . Birds of prey, Waterfowl, Gallinaceous, Passerine and Woodpeckers). Students should be able to make observations about proportion and shape of bill and relate the shape distinctions to diet and functional differences. Hypothesize function from form. What makes each of these families unique?

III.d. Diet and Dento-Facial Adaptations

Using the Quicktime VR images, compare the Fox/Coyote/Wolf. These species can be found in the same ecosystem and yet each is adapted for a unique niche. Students should look specifically at size of skull, length of teeth, shape of snout, etc. Can your students infer from these observations any hypotheses about feeding habits?

Authored by Susan Metcalfe and Robert Costello

BEGINNING BOTANY WITH CAMAS

Gail McEachron

CAMAS

The Camas plant (*Camassia quamash*) has a bright blue or white stalk of flowers and a bulb covered with black bark. It is a member of the lily family. In 1832, the botanist John Lindley named the plant *Camassia escuelente*. Frederick Pursh (1814) was the first to describe the plant in Latin, naming the genus *phalangium*. In 1894, Edward L. Greene (1894) changed the genus name back to *camassia*, but kept the species *quamash* from Pursh. Since Pursh was the first to describe the plant in Latin according to code, his name, rather than Greene's, is usually depicted in parentheses in scientific references. There are two Western species, *C. esculenta* and *C. leichlini*, growing in moist meadows from California to British Columbia and Montana (Coues, 1965).

Credit: Smithsonian Institution Photo

Credit: Smithsonian Institution Photo

Camas has been harvested by several tribes and used for a variety of purposes (Moerman, 1998, p. 134):

Native American Group	Uses
	Medicinal:
Blackfoot	Gynecological aid during birth
	Food:
Blackfoot	Bread and cake
Chehalis	Soup
Cowichan	Bulbs served at potlatches

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Flathead	Beverage, soup
Hesquiat	Steamed vegetable
Karok	Vegetable cooked in pit
Klamath	Dried
Nez Perce	Cash crop traded to Gros Ventre and Crow

When Camas blooms in the springtime, the flowers are thick and can give the appearance of a blue lake from a distance. After the seed ripens, the bulbs may be dug, an activity traditionally done by Native American women and children. They usually do the digging with a crooked-nosed stick, which has been hardened in fire. Both hands are placed on the handle, and body weight is applied until a depth of about six inches is reached (Spinden, 1908, p. 200). A parfleche, bag made from animal skin, was typically used to hold the bulbs (Murphey, 1993).

After the women and children spend days bringing in sacks of bulbs, the tribal communities sometimes celebrate the harvest by having a festival. When there is an adequate harvest, the cooking begins. Nearly a half century ago, Murphey (1993) described the activities:

> The men's part is to bring in hard wood and green branches to roast the camas. After a day's burning of wood down to coals, the bulbs have been washed, and the coals are raked out, leaving a bed of warm ashes. This is usually about 20 feet in diameter. Green branches of alder or birch are laid down, and along the branches are placed the camas bulbs. Next a layer of ashes, then some slow coals, more ashes, more branches[,] more camas, and so on until all the bulbs have been placed. Branches and layers of dry grass cover the top.
>
> The camas pit is divided among four women who see to it that a supply of coals and ashes is on hand to keep the cooking going. From 24 to 36 hours is needed to complete the job. During this time, neighbors visit, sometimes deer or antelope are barbecued, and bubbling pots send forth appetizing odors.
>
> When the camas is ready to eat, large, flat openwork willow baskets are brought to the side of the pit, and with forked sticks used as tongs, the bulbs are laid on the baskets to cool, as they are too hot to handle. When they are merely warm, the black bark is stripped from them, and the bulbs are pressed between women's hands, until they look like macaroons or ginger snaps. The fragrance is delightful like vanilla cake.

More recently, Caroline James interviewed women of the Nez Perce Tribe as a way to preserve their cultural traditions. In her book, Nez Perce Women in Transition, 1877-1990 (1996, p. 12), James documents the way Nez Perce women prepared camas roots before the use of machines. The bulbs were gathered in the wet upland meadows – The Weippe Meadows and Camas Prairie north of Grangeville, Idaho; the Palouse Prairie near Moscow, Idaho; the Elk City, Idaho, area; and the Grande Ronde Valley of

eastern Oregon. According to one young interviewee who grew up in a longhouse on Nesplem Reservation:

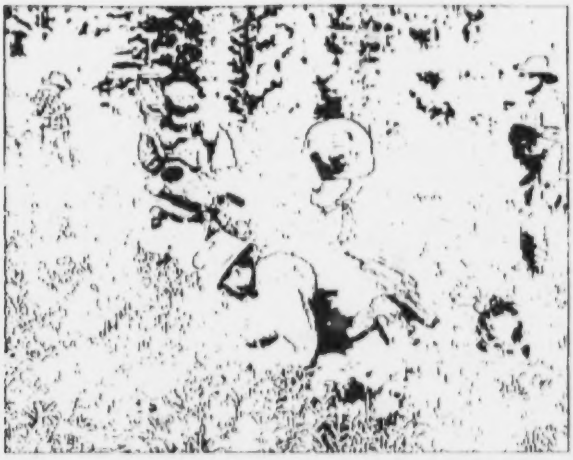
> *When I was fourteen years old, my mother brought me to Mrs . Cleveland's house in Nespelem. ...we went out root digging. ...That was the first time I had dug roots with these people, that certain people from the long house. Previously, I had dug roots with my grandmother, Carrie Innes, ...Women cleaned the roots in their hands...Most of the roots have covering on them. There was an old lady who lived in this area, and she used a little rock like a knife to peel off the skin or the covering.*

Credit: Smithsonian Institution Photo

The Nez Perce describe how camas was prepared for immediate use and baked for use in later months. Camas roots were baked and steamed in a large pit for a few days and never eaten raw. For immediate consumption, the cooked roots could then be made into a porridge or boiled in water (James, p. 13). When the cooked roots turned from white to brown, the taste became sweeter. In the words of one Nez Perce woman (James, 1996, p. 17): *"My grandmother would dig to check how far along they were cooking and then dig them out...When they are fresh it was just like candy to us..."*

Because baked camas did not keep well, the cooked roots were pounded and dried as a meal called *kom'es'es.* They were then formed into loaves, rolled in bunch grass (*Agropyron sp.),* and again steamed. After cooking, the loaves were made into smaller cakes, known as *ep'ine,* and dried in the sun or over a campfire. These were stored for winter use. Since Clark was offered camas bread with salmon when he encountered the Nez Perce on September 20, 1805, it is possible that he ate camas that had been prepared in this manner.

The following account of camas preparation provided by an eighty-two-year-old woman suggests that it is rare to observe the traditional way of harvesting camas roots: *"Baking camas, it's a lot of hard work. Only one woman bake the camas. She has most of her grandchildren do for her. She is lucky to have a lot of help. They don't do digging by hands anymore, but they now do it by machine"*(James, 1996, p. 17).



Credit: Smithsonian Institution Photo

BEGINNING BOTANY WITH CAMAS

Lesson Plan for Primary Students

Grade Levels Primary (1-3)
Time Two Hours

Purpose The purpose of this lesson is for students to learn fundamental principles of botany by studying the history and characteristics of the camas plant.

Previous Knowledge Assume that this lesson will be an interdisciplinary extension to lessons describing the Lewis and Clark Expedition. This lesson should follow a viewing of the Smithsonian website which depicts a scientific specimen of the camas plant, a picture of the camas flower, a picture of flowers in the lily family, a picture of a field of blue camas from Idaho, a child's drawing of camas, Nez Perce artifacts, and a photograph of Camas Prairie.

Objectives

1. Given Smithsonian website depicting pictures of scientific specimen and field of camas, students will observe characteristics.
2. Given teacher demonstration, students will listen to lesson about the lily family and point out characteristics of plants in the lily family.
3. Given regional flowers, students will draw and label parts, indicating name and family of flower as well as parts specified by the teacher.

Procedure

Motivation: Provide students with background information about camas such as the context in which it was introduced to Lewis and Clark on the Lolo Trail. Describe and show pictures of the Nez Perce children and artifacts made by Nez Perce. Discuss their function in relation to gathering and storing food such as camas roots.

Content Focus: Show a picture of the camas flower. Explain that scientists, called botanists, study the plants in addition to admiring their beauty. Explain that botanists study plants in terms of characteristics such as appearance, and economic uses. Economic uses would include whether or not the plant could be eaten, used for other purposes like making medicine or dyes for paint, or traded as a crop. Point out that this lesson will focus on the way botanists study the parts of the camas plant and classify it into categories. See Background Information for details. Show family tree excerpt from Eyewitness Visual Dictionary. Take students through the classification process for the lily and point out that the camas plant that the Nez Perce harvested and ate was a part of the lily family. Make analogy to their own families, pointing out that they may have certain characteristics in common such as blue, hazel, or brown eyes, but that each person in the family has unique characteristics because no two people are exactly alike, even identical twins. Discuss the characteristics that make the camas plant part of the lily family.

Show selected flowers from the lily family and ask students to count the number of stamens, describe the bulbs, and examine the parallel veins. Show the picture of the camas plant drawn by a child, mostly likely from Idaho since the picture is from the University of Idaho website. Discuss how the student captured some of the characteristics of the plants from the lily family, e.g., bulb and long stem. Explain that they, too, will draw pictures of flowers. Distribute a regional flower to students in groups of 3 or 4. List of state flowers are provided in Background Information. Ask them to draw their state or regional flower, label three parts as specified by teacher, and write the species and family name. Simplify the labeling process based on individual abilities. Find pictures of other flowers that are in the same family as the flower distributed. Ask students to identify similar characteristics and make inferences about why they think scientists placed the flowers in the same family.

Closure: Ask students to hold up their drawings from their seats. Students should be able to identify essential features of the plant and the flower (e.g., petals, stamen, stem, leaves, root). Ask students to share their inferences about why scientists put the flowers they studied in the same family. Answers will vary depending on the flowers selected by teacher (Example: Family: Lily; Genus: Camassia; Species: Quamash).

Evaluation

- Students' labeled drawings of flower including species, family and those parts designated by the teacher.
- Students' inferences about why two flowers may be in the same family.

Background Information

For Teacher:

The system of classification used by botanists results in repeated subdivisions that are sometimes referred to as a "family tree." See illustration of tree from Eyewitness Visual Dictionary.

Kingdom:	Plantae
Phylum:	Angiospermophyta (flowering plants)
Class:	Monocotyledoneae (monocotyledons)
Family:	Liliaceae (lily)
Genus:	Camassia
Species:	quamash

Monocotyledons typically have seeds with one seed leaf (cotyledon). Their foliage leaves are narrow with parallel veins and the flower components typically occur in multiples of three (Lindsay, 1992). Sepals and petals are indistinguishable and are known as tepals. Most monocotyledons are herbaceous (typically having green non-woody stems and are relatively short-lived—one to two years).

The Lily Family (*Liliaceae*) is one of the largest families of flowering plants, including approximately 250 genera and 3,500 species. The economic uses include popular ornamentals (e.g., lilies, tulips, hyacinths), vegetables (e.g., onions, leeks, garlic and asparagus) and some medicinal uses (e.g., bitter aloes) (Heywood, 1985).

For Primary Children (use selected information as appropriate):

Characteristics of plants/flowers in Lily Family:

1. Swollen storage organs such as bulbs, corms, rhizomes or thick, fleshy roots
   Basic: Swollen storage parts such as bulbs and thick roots
2. Narrow leaves with parallel veins (illustrate).
3. Usually six stamens (rarely 3 or up to 12)

STATE FLOWERS:

1	Alabama	*Camellia*	26	Montana	bitterroot
2	Alaska	wild forget-me-not	27	Nebraska	goldenrod
3	Arizona	saguaro cactus blossom	28	Nevada	sagebrush
4	Arkansas	apple blossom	29	New Hampshire	purple lilac
5	California	golden poppy	30	New Jersey	violet

6	Colorado	Rocky Mtn. columbine	31	New Mexico	yucca
7	Connecticut	mountain laurel	32	New York	rose
8	Delaware	peach blossom	33	North Carolina	dogwood
9	Florida	orange blossom	34	North Dakota	wild prairie rose
10	Georgia	Cherokee rose	35	Ohio	scarlet carnation
11	Hawaii	Pua aloalo (hibiscus)	36	Oklahoma	mistletoe
12	Idaho	*Syringa*	37	Oregon	Oregon grape
13	Illinois	violet	38	Pennsylvania	mountain laurel
14	Indiana	peony	39	Rhode Island	violet
15	Iowa	wild rose	40	South Carolina	yellow jessamine
16	Kansas	wild native sunflower	41	South Dakota	pasqueflower
17	Kentucky	goldenrod	42	Tennessee	iris/passion flower
18	Louisiana	*Magnolia*	43	Texas	bluebonnet
19	Maine	white pine cone & tassel	44	Utah	sego Lily
20	Maryland	blackeyed Susan	45	Vermont	red clover
21	Massachusetts	mayflower	46	Virginia	dogwood
22	Michigan	apple blossom	47	Washington	western rhododendron
23	Minnesota	pink & white lady's-slipper	48	West Virginia	*Rhodendron maximum*
24	Mississippi	*Magnolia*	49	Wisconsin	Wood Violet
25	Missouri	hawthorn blossom	50	Wyoming	Indian paintbrush

Materials

Smithsonian Website - Lewis & Clark as Naturalists
(http://www.mnh.si.edu/lewisandclark), *Camassia quamash* (Pursh) Greene - Pictures of: camas scientific sample, field of camas, lilies,

Using resources listed in References (below) and in classroom: family tree of lily, flowers in lily family, real flowers, paper and markers or crayons. Students may enjoy reading Thunder rolling in the mountains or Soun Tetoken: Nez Perce boy.

Education Standards

National Science Education Standards: (http://www.nap.edu/html/nses/html/)
Life Science C: characteristics and life cycles
(http://www.nap.edu/html/nses/html/6c.html#ls)

National History Standards: (http://w3.iac.net/~pfilio/hstst.htm)

National Council for the Social Studies: (http://www.ncss.org/)

Virginia Standards of Learning:
(http://www.pen.k12.va.us/VDOE/Superintendent/Sols/home.shtml)

Science

K.1 The student will conduct investigations in which
- Objects are described both pictorially and verbally

1.4 The student will investigate and understand that plants have life needs and functional parts and can be classified according to certain characteristics
- Parts (seeds, roots, stems, leaves, blossom, fruit)

2.4 The student will investigate and understand that plants and animals go through a series of orderly changes in their life cycles. Key concepts include:
- Flowering plants undergo many changes from the formation of the flower to the development of the fruit

3.5 The student will investigate and understand relationships among organisms in aquatic and terrestrial food chains. Key concepts include:
- Producer, consumer, decomposer;
- Herbivore, carnivore, omnivore; and
- Predator—prey

4.4 The student will investigate and understand basic plant anatomy and life processes. Key concepts include:
- The structures of typical plants(leaves, stems, roots, and flowers);
- Processes and structures involved with reproduction (pollination, stamen, pistil, sepal, embryo, spore, and seed);

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History and Social Science

History

K.1 The student will understand that history relates to events and people of other times and places by

- Identifying examples of past events in legends and historical accounts, ...
- Identifying examples of interesting Americans through exposure to biographies of important people of the past, ...

1.1 The student will compare everyday life indifferent places and times and recognized that people, places, and things change over time through such comparisons as

- Contemporary American life with American life in previous time periods

2.3 The student will compare the tribes of American Indians in Virginia with nomadic (e.g., Sioux) and settled, agricultural tribes (e.g., Pueblo) in other regions in America

3.2 The student will describe the discovery of the Americas by Columbus and other European explorers and also the first permanent Spanish, French, and English settlements in North America, with emphasis on the people (explorers and their sponsors), their motivations, and the obstacles they encountered, and the successes they achieved.

Economics

K.5 The student will match simple descriptions of work that people do and the names of those jobs with examples from the local community and historical accounts

3.6 The student will describe the economic specialization and interdependence involved in the production of goods and services in various types of communities in the past

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Web Sites:

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CLARK'S NUTCRACKER

Gail McEachron

On August 22, 1805, near the present town of Tendoy, Idaho, Clark wrote:

I saw today a Bird of the woodpecker kind which fed on Pine burs its Bill and tale white the wings black every other part of a light brown, and about the size of a robin.

Although originally mistaken as a woodpecker, Clark's description refers to what is currently called Clark's Nutcracker (*Nucifraga columbiana*). It is a jay-sized corvid that is crowlike in build and flight, averaging 27-30 cm in length, with males weighing approximately 141 g and females approximately 129 g. The sexes are similar in appearance, light to medium gray, with varying amounts of white around the eyes, on forehead, and on the chin; white around vent and at base of tail; wings and tail glossy black; secondaries broadly tipped with white (forming a white patch); outer rectrices white. It has a long, pointed, black bill with short nasal bristles (nares covered). It has a distinctive grating call that can be heard at great distance.

Photo by Albert P. Bekker
© California Academy of Sciences

Clark's Nutcracker

Photo by Carl Hansen
Smithsonian Institution

Lake and Forest on Lolo Trail

One of the distinguishing characteristics of Clark's Nutcracker is its sublingual pouch, shared only by the Spotted nutcracker (*Nucifraga caryocatactes*) of Eurasia. It is formed by ventral diverticulum on floor of mouth between mandibular rami. The opening to the pouch lies under the tongue. The pouch bulges massively in throat region when filled with seeds, holding as many as 150 [whitebark] at one time.

Habitat for Clark's Nutcracker

Clark's Nutcracker lives in the mountain regions of the western United States and Canada, preferring a coniferous forest with large-seeded pines. "All

nutcracker-dependent pines have large, wingless seeds that are not effectively dispersed by wind; also, seeds are retained in ripe whitebark and pinon pine cones; trees tend to have upswept branches with cones conspicuous on tips"(Tomback, p. 8). The pictures below show one of the pines on the Lolo Trail that most likely were encountered during the Lewis and Clark expedition.

Photo by Carl Hansen
Smithsonian Institution

Whitebark Pine

Pines on the Lolo Trail

Clark's Nutcracker plays a key role in the survival of several pines. Seed dispersal by Clark's Nutcracker has resulted in a commonly occurring tree cluster growth form in three of the following pines—whitebark (*Pinus albicaulis*), limber (*P. flexilis*), Colorado pinon (*P. edulis*), single-leaf pinon (*P. monophylla*), and southwestern white (*P. strobiformis*). As a result, Clark's Nutcracker has played a role in altering their genetic population structure in comparison to wind-dispersed pines (Tomback, 1998, p. 1).

Clark observed the most frequent pastime of Clark's Nutcracker—collecting pine seeds. The annual cycle of the nutcracker is closely tied to its dietary needs so collecting, storing, and retrieving stored seeds consume a great amount of the nutcracker's time. It begins by prying the cones open with its bill and extracting the seeds. If hungry, it may eat some after crushing them in its beak, but most are slipped into the elastic pouch under the tongue. Once the pouch is full, the nutcracker flaps heavily away to an area of open ground where it digs a series of holes with its bill and deposits a few seeds in each one (Cassidy, 1990). Ornithologists (scientists who study birds) observed individual nutcracker caches in late summer and fall, noting the following pattern of collected pine seeds:

Pine	Number of Seeds
Colorado pinon	*22,000 – 33,000*
Whitebark pine (Study 1)	35,000
Whitebark pine (Study 2)	98,000
Single-leaf pinon (Study 1)	7,000
Single-leaf pinon (Study 2)	17,900
Limber pine	16,300

The total number of seeds cached by one Clark's Nutcracker in one year depends on the cone crop size, availability of other cone crops, harvest duration, estimates of number of trips per day, and estimates of sublingual pouch load, which varies with age and body mass of nutcracker (Tomback, 1998). Clark's Nutcracker has a highly developed spatial memory which means that it has an "uncanny knack for finding the stashes many months later"(Cassidy, 1990, p. 66). It uses the retrieved seeds for food during the winter and spring as well as to feed its young during nesting season. Certainly not all seeds are retrieved and the remaining seeds often grow into the pines that feed future generations of nutcrackers.

Photo by Carl Hansen
Smithsonian Institution

Pine Cones

CLARK'S NUTCRACKER
Lesson Plan for Middle School Students

Grade Levels Middle School (6-8)
Time One Hour Teacher Directed; Several Days for Field Research

Purpose The purpose of this lesson is to demonstrate the interdependence between Clark's Nutcracker and selected pine trees. Both contribute to each other's survival.

Previous Knowledge Assume that this lesson will be an interdisciplinary extension to lessons describing the Lewis and Clark Expedition. This lesson should follow a viewing of the Smithsonian primary resources featuring Clark's Nutcracker, pine trees, and pinecones.

Objectives

1. Given Smithsonian website and handout of Clark's Nutcracker bird calls, students will match the sound on the website to the pictograph.
2. Given access to free roaming birds, students will sketch bird(s), tape-record, and draw pictograph of bird calls.
3. Given field research, students will compare and contrast the bird calls of Clark's Nutcracker and the birds in their region.

Procedure

Motivation: Provide students with background information about Clark's Nutcracker such as the context in which it was identified by William Clark on the Lolo Trail as well as its characteristics. Show picture if available or inform students that they will see a picture on the internet. Direct students to the Smithsonian website where they can read about Clark's Nutcracker and listen to six of the calls it makes. Distribute the handout of the sounds and ask students to match the sound to the pictograph. Explain that the range of bird calls helps the bird survive by communicating a variety of needs such as hunger, excitement, territoriality, contact, mating, location, threat, and bonding.

Supplement handout with scientific research in Background Information section.

Content Focus: Ask students to name some of the birds they are familiar with in their own region. Explain that over a period of several days they will conduct field research similar to that done by the ornithologists (L. R. Mewaldt and D. F. Tomback) who collected data about Clark's Nutcracker. Provide pairs of students with audio tapes and recorders, timing devices with second hands, sketch paper, pencils, binoculars, and graph paper that is divided into second intervals like the handout of Clark's Nutcracker. Ask students to sketch the bird they observe, record the sounds it makes, and draw images of the sounds the bird makes on the graph paper. Before students get started, ask them to make predictions about how they think the sounds they record may be similar or different to the sounds made by Clark's Nutcracker. In cases where birds are not making many sounds, students can record other behaviors such as flight patterns, eating, drinking, and/or nesting.

Closure: Identify a large area where students can display their sound graphs. In pairs, ask students to describe their findings and play excerpts from their audio tapes. Or better yet, include bird calling as an option to enhance the originality of their presentation. [Explain that bird calling is practically a sporting event around the world]. After all students have presented their findings, ask students to identify patterns in the research. Ask students to compare their research with the patterns of Clark's Nutcracker.

Evaluation

- Students' tape recorded sounds of bird calls; sketches of birds; pictographs.
- Students' comparisons between the calls of birds in their region and the calls of Clark's Nutcracker.

Background Information

Vocalizations (Tomback, 1998, pp. 9-10):

Group I: Characterized by broad bands of low-frequency sound, occasionally with overtones.

Regular Call; Fast Locational Call. Sharp, rapid *kraaks* or *kraas;* grating, noisy
Sound. Contact call, often given in flight or when no other birds are in sight.

Slow Locational Call. Drawn out *kraaaack* or *kraaaa*, with many variants.
Contact call often exchanged by birds in same stand of trees.

Group II: Have broad bands of low-frequency sounds of short duration. They are uncommon year-round, but most common February through September, probably serving a pair-bonding function.

Hiccup Call. Rhythmic, throaty clicks. Soft call given by female in presence of male, accompanied by neck-stretching. Also used by lone juveniles.

Crackle- and *Whistle Call; Crackle Call.* Soft, alternating crackles and wheezing whistles; accompanied by neck stretching and bowing; both sexes, particularly March and April.

Group III: Have low fundamental frequences with 420 harmonics at 0.20-1.20-kHz intervals.

Hunger Call. Urgent, repetitive *aaaa*; juvenile food-begging call, given near parent. Heard may-late August. Speeds up as parent approaches with food.

Shrill Call; Mew Call. Decreasing in pitch; *meerk* or *mew;* common year-round; given by both sexes. Often exchanged among nutcrackers perched in same or adjacent trees.

Materials

Primary Resources—Images of Clark's Nutcracker from Smithsonian web site (http://www.mnh.si.edu/lewisandclark); pines and pinecones; sound recordings of bird calls; sketch paper; pencils; timing devices; audio tape recorder; graph paper; binoculars (if available).

Education Standards

National Science Education Standards: (http://www.nap.edu/html/nses/html/) Life Science C; Science and Technology E; History and Nature of Science G

National Council for the Social Studies: (http://www.ncss.org/) Culture, b., e., d.; Science, Technology, and Society d.

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GRIZZLY SURVIVAL

Gail McEachron

Early Accounts

The journals of Lewis and Clark include detailed references to the "monstrous beast" which they designated as the brown, yellow, white, or variegated bear. This seemingly monstrous bear was the grizzly (*Ursus arctos horribilis)*, which they claimed was the fiercest, largest, and most intelligent quadruped on the North American continent. Excerpts from Lewis' journal reveal the sense of awe that he felt toward the grizzly.

> *Monday April 29th 1805*
>
> Set out this morning at the usual hour; the wind was moderate; I walked onshore with one man. About 8 A.M. we fell in with two brown or yellow (white) bear; both of which we wounded; one of them made his escape; the other after my firing on him purused [sic] me seventy or eighty yards; but fortunately had been so badly wounded that he was unable to pursue so closely as to prevent my charging my gun. We again repeated our fire and killed him. It was a male not fully grown; we estimated his weight at 300 lb. not having the means of ascertaining it precisely. The legs of this bear are somewhat longer than those of the black, as are it's tallons and tusks imcomparably [sic] larger and longer. ...It's colour is yellowish brown, the eyes small, black, and piercing; the front of the forelegs near the feet is usually black; the fur is finer, thicker and deeper than that of the black bear. ...it is a much more furious and formidable anamal, [sic] and will frequently pursue the hunter when wounded. It is astonishing to see the wounds they will bear before they can be put to death. The Indians may well fear this anamal equiped as they generally are with their bows and arrows or indifferent fuzees, but in the hands of skillful riflemen they are by no means as formidable or dangerous as they have been represented.

Native Americans both feared and revered the grizzly bear. Blackfeet Indians avoided the grizzly and regarded it as a sacred animal of great supernatural and physical power. To the Blackfoot, the grizzly was part bear and part human, and only the buffalo received greater veneration. Blackfeet traditions indicate that when there are medicine bundles hanging in the tipi, it is necessary to refer to the grizzly bear using descriptive terms, but not the generic name of the bear. In speaking of a particular grizzly, "sticky mouth" is a term often used by the Blackfeet (Hallowell, 1926, p. 47).

Native Americans created ceremonies to express the meaning of their relationships with bears. These ceremonies might occur before or after killing the bear. In a painting by George Catlin, for example, *The White Cloud,* head chief of the Iowas, is depicted wearing a necklace of grizzly claws and painted as if ready to hunt the huge animal. In some tribes, a necklace of grizzly claws was thought to provide great courage and strength to the wearer.

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The anthropologist, A. Irving Hallowell (1926, p. 57), studied the relationship between humans and animals, making the following observation about Ojibway traditions:

> In addition to the apologetic note which characterizes so many of the conciliatory speeches made to bears, ...there are several variant features worthy of notice....one of the most interesting and important of these is the custom of telling the beast that its slayers are not its slayers. That is, the responsibility is frequently shifted to a fictitious agency. In North America the clearest case of this sort I have found recorded is in Henry's account of the Ojibway, in which the animal is assured that an Englishman put it to death and not an Indian.

From these early accounts of grizzly behavior and folklore, scientists have expanded knowledge of grizzly habitat and behavior. They have challenged the image of the grizzly as "monstrous" and at the same time have confirmed these behaviors under certain conditions, such as when provoked by humans.

Credit: Photo by Gerald and Buff Corsi © California Academy of Sciences

Characteristics

The largest documented grizzly was shot on Kodiak Island in 1894, weighing 1,656 pounds (753 kg) (Busch, 22). However, grizzlies over 1,000 pounds are rare, most range approximately between 200 and 700 pounds. One of the reasons humans are so attracted to bears is that they are similar to the human form when standing upright. Male grizzlies can measure 8 feet (2 m) from nose to tail. Despite their massive size, grizzlies can easily run 35 miles (53 km) per hour. "One sow grizzly was known to have

chased a truck full of park wardens at a speed of just over 40 miles per hour for a short distance before returning to her cubs" (Busch, 24). Strength more than speed is the primary basis for grizzly survival. "The power of these animals is just awesome," stated biologist Gordon Stenhouse after watching a large grizzly run effortlessly down a steep mountain slope with a 300-pound sheep in its mouth (Busch, 24).

The word "grizzly" comes from the Old French term *grisel*, meaning grayish. A typical grizzled appearance comes from the interspersal of silver-tipped hair scattered throughout the bear's coat (Busch, 27). Although most grizzly bears are a medium brown, their fur color ranges from golden to dark brown. Grizzlies shed their fur between June and August. This molted fur is often gathered by squirrels for lining their dens.

Scientists study the teeth of mammals for clues about their diet and age. The molars of most carnivores are *carnassial*, which means that they are sharply pointed and can be used to shear off bits of meat (Busch, 30). In grizzlies, however, the molars are *occludal*, meaning they are broad with flat crowns, which is an adaptation for crushing vegetation. Human molars have a regular pattern of bumps and hollows, whereas the surface of grizzly molars is irregular, "as if carnassials had been modified, which is what has happened during the evolution of the bear"(Busch, p. 30). Studying the rings on the teeth provides clues about the age of the grizzly, a process very similar to studying tree rings.

Credit: Credit: Smithsonian Institution Photo

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The tracks of grizzlies have sometimes been mistaken for human footprints. The grizzly tracks have large hindpaw imprints and smaller forepaw prints. Grizzlies walk in a *plantigrade* fashion, placing their feet on the sole. By contrast, dogs are *digitigrade* walkers, meaning they walk on their toes, an adaptation for improved running speed (Busch, 33). The hindprint of a large grizzly can measure 10 to 12 inches (25 to 30 cm) long and 6 inches (15 cm) wide. One way to distinguish grizzly tracks from black bear tracks is by the size of the claw marks. Grizzly claws are longer, leaving 1 to 2 inch impressions.

Credit: Roger W. Barbour ©

Habitat Changes in the Northwest

Frank and John Craighead are two naturalists, and brothers, who began a longitudinal study of the grizzly in 1959 in Yellowstone National Park and four adjacent national forests. John Craighead was a leader of the Montana Cooperative Wildlife Research Unit at the University of Montana. Frank represented the Environmental Research Institute of Moose, Wyoming. The ecosystem, which was home to one of the largest remnant populations of grizzlies in the lower forty-eight states, encompassed about 5 million acres. At the time their study began, the grizzly was not overhunted. Reliable scientific information on the grizzly was extremely limited due to the grizzly's shyness, its tendency to be nocturnal, its wild and rugged habitat, and the dangers of getting close to the bears. The Craigheads' research investigated how much territory and privacy the grizzly needed, how the presence of greater numbers of humans in the ecosystem might affect them, and how large a viable population is. The Craigheads knew that their research was important if the Yellowstone ecosystem should continue as a refuge for grizzlies.

The Craigheads captured the bears in a culvert trap or tranquilized them with a dart. Once immobilized, a small numbered metal tag was clamped in each ear and plastic rope markers of various distinctive colors were inserted. The markers enabled the Craigheads to recognize individual bears from a distance. Originally, the Craigheads intended their research to be on a long-range basis. They observed the behavior of individual bears from year-to-year, kept track of changes in the social organization of the bear community, and tried to determine the size, composition, and growth trends of the population and the natural and imposed factors that influenced the population.

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The Craigheads concluded from their research that the grizzly is a tough, rugged individual adapted to survive to the age of thirty years or more. The grizzly does not have enemies, with the exception of the white man and his rifle. Prior to the arrival of the white man, conflicts between bears and man occasionally terminated in the death the bear or the man, but these events were rare. Their more natural causes of death were the result of old age, trichina (roundworm) infection, infanticide, and occasional combat wounds from "being gored by a bison or large bull elk the grizzly has tried to bring down"(Craighead, 1979, p. 178).

Due to changes in administrative policy in Yellowstone Park in 1968, the Craigheads' field work was terminated. According to Frank Craighead, "the new policies were very nearly disastrous to the grizzly community"(Craighead, 1979, p. 11). His book Track of the Grizzly outlines the impact of policy changes up to the 1970s. To understand the long-term significance of the Craigheads' research, consult http://www.lewis-clark.org/griz/gri_mmnu.htm, http://www.lewis-clark.org/griz/griz_graph.htm and http://www.lewis-clark.org/griz/map_grizbr.htm for reports on reintroducing this species into the Bitterroot Mountains. This site explains some of the conservation efforts underway on behalf of the grizzly, turning around the temporary population reduction that began in the 1970s.

GRIZZLY SURVIVAL

Lesson Plan for Upper Elementary Students

Grade Levels Fourth and Fifth
Time One to Two Hours

Purpose Students will develop a greater appreciation for the role that humans play in preserving grizzlies and their habitat. The Lewis and Clark expedition lead to an increase in human settlements, resulting in a decrease in the grizzly population.

Previous Knowledge Assume that this lesson will be an extension to lessons describing the Lewis and Clark Expedition. This lesson should follow a viewing of the Smithsonian primary resources featuring the grizzly skull and pictures of the grizzly.

Objectives

1. Given data of grizzly research conducted by Frank C. Craighead, students will make inferences about the recorded deaths of grizzlies.
2. Given internet links, students will investigate the survival patterns of grizzlies in the present time period.
3. Given research, students will make interpretations about the interaction between humans and grizzlies.

Procedure

Motivation. Show students pictures (Handouts 1 and 2) of the range of grizzly habitat in the early 1800s compared with the present. Ask them to hypothesize about the differences over time. Pose questions such as, "What natural factors may have contributed to the reduction of territory?" "What human factors influenced the retraction further north?" Record student responses on board or overhead.

Content Focus. Give a brief biographical sketch of Frank Craighead. Distribute Craighead's *Table 1: Recorded deaths of grizzly bears in the Yellowstone Ecosystem, 1959-1967* (Handout 3). In small groups, ask students to makes inferences about the data, emphasize comparisons between human and natural causes. Possible student outcomes: Natural deaths from bear/bear death, disease, age—3; deaths from human intervention—129. Ask more probing questions about the data such as, "Were there changes in the frequency of deaths over time?" "What might account for the changes?"

Explain the important role that Craighead played in bringing awareness of grizzly behavior to park wardens as well as the negative effects that humans can have as a result of ignorance about bears. Explain that while there was a period of negative relationships between the grizzly and humans in the period after Craighead's research was conducted, recent efforts have been more positive.

Direct students to http://www.lewis-clark.org and ask them to research the positive steps that are being taken on behalf of the grizzly.

Closure. Ask students to return to the original questions posed in the beginning of the lesson: "What natural factors may have contributed to the reduction of territory?" "What human factors influenced the retraction further north?" Ask students if they would extend or modify their earlier responses based on their studies of grizzly habitat.

Conclude by pointing out that while investigations of contemporary issues and one longitudinal study cannot give a complete explanation for the reduction of the range of grizzly habitat over a 200 year period, they, nevertheless, illustrate the importance of scientific research which investigates the interrelationships between humans and mammals.

Remind students that Lewis and Clark are viewed as making important contributions as naturalists because of their extensive documentation of the plants and animals they encountered. In light of what happened to the grizzly over the 200 years since they were documented in the Lewis and Clark journals, ask students to identify the factors that contributed negatively to the grizzly ecosystem and what steps were taken to correct the negative impact of human behavior and policies. Student outcomes might include: negative—overhunting, hunting for sport, ignorance about grizzly habitat, human settlement; positive—hunting regulations, national parks as preservation for grizzly, scientific research influencing policy decisions, federal and state policies, educating the public.

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Evaluation

- Students' interpretations of historic versus contemporary biogeographic maps
- Students' hypotheses about the factors contributing to the retreating grizzly population
- Students' interpretations of Craighead research on grizzly deaths
- Students' interpretations of relationship between human and animal survival

Background Information

Review information about grizzly and the Craigheads. To navigate the website cited above to the point of viewing contemporary policy efforts, click on the following:

1. Exploration
2. 6. High on the Plains
3. grizzly bears
4. Recovery
5. Recovery Plan (bottom of picture)
6. [Read about Recovery Plan, then...]
   All three choices:
   Record of Decision and Final Rule for Grizzly Bear Recovery in the Bitterroot
   Interagency Grizzly Bear Committee
   National Wildlife Federation

Materials

Smithsonian Web Site: Lewis & Clark as Naturalists (http://www.mnh.edu/lewisandclark) - grizzly skull, photos of grizzly; Catlin painting *The White Cloud, Head Chief of the Iowas*; pictures of bear range prior to and after 1850; information on changes of bear populations (Craighead or http://www.lewis-clark.org/griz/map_grizbr.htm); reference materials.

Education Standards

National Science Education Standards: (http://www.nap.edu/html/nses/html/) Life Science C; Science and Technology E; History and Nature of Science G [detailed version below]

National History Standards: (http://w3.iac.net/~pfilio/hstst.htm) 1A [detailed version below]

National Council for the Social Studies: (http://www.ncss.org/) Culture, b., c., d.; Science, Technology, and Society d.

National Geography Standards: (http://www.ncge.org/publications/tutorial/) Environment and Society

National Standards for Art Education:

(http://www.ed.gov/pubs/ArtsStandards.html) Understanding the Visual Arts in Relation to History and Cultures, a-c.

Virginia Standards of Learning:

(http://www.pen.k12.va.us/VDOE/Superintendent/Sols/home.shtml) Science 4.1, 4.5; 6.9; Social Studies 5.6

Science

Science Standards (Taken verbatim from National Science Education Standards, 1996, National Academy Press, 2101 Constitution Avenue, NW, Box 285, Washington, DC 20055).

Content Standards: 5-8 (Those with a * indicate selected standards for *Lewis and Clark as Naturalists* Project)

Science as Inquiry
Physical Science
Life Science*
Earth and Space Science
Science and Technology*
Science in Personal and Social Perspectives
History and Nature of Science*

LIFE SCIENCE (Selected)

Content Standard C: As a result of their activities in grades 5-8, all students should develop understanding of

- Structure and function in living systems
- Reproduction and heredity
- Regulation and behavior
- Populations and ecosystems
- Diversity and adaptations of organisms

Populations and Ecosystems

- A population consists of all individuals of a species that occur together at a given place and time. All populations living together and the physical factors with which they interact compose an ecosystem.
- Populations of organisms can be categorized by the function they serve in an ecosystem. Plants and some micro-organisms are producers—they make their own food. All animals, including humans, are consumers, which obtain food by eating other organisms. Decomposers, primarily bacteria and fungi, are consumers that

use wasted materials and dead organisms for food. Food webs identify the relationships among producers, consumers, and decomposers in an ecosystem.

- The number of organisms an ecosystem can support depends on the resources available and abiotic factors, such as quantity of light and water, range of temperatures, and soil composition. Given adequate biotic and abiotic resources and no disease or predators, populations (including humans) increase at rapid rates. Lack of resources and other factors, such as predation and climate, limit the growth of populations in specific niches in the ecosystem.

Diversity and Adaptations of Organisms

- Millions of species of animals, plants, and microorganisms are alive today. Although different species might look dissimilar, the unity among organisms becomes apparent from an analysis of internal structures, the similarity of their chemical processes, and the evidence of common ancestry.
- Biological evolution accounts for the diversity of species developed through gradual processes over many generations. Species acquire many of their unique characteristics through biological adaptations, which involves the selection of naturally occurring variations in populations. Biological adaptations include changes in structures, behaviors, or physiology that enhance survival and reproductive success in a particular environment.
- Extinction of a species occurs when the environment changes and the adaptive characteristics of a species are insufficient to allow its survival. Fossils indicate that many organisms that lived long ago are extinct. Extinction of species is common; most of the species that have lived on the earth no longer exist.

SCIENCE AND TECHNOLOGY (Selected)

Content Standard E: As a result of activities in grades 5-8, all students should develop

- Abilities of technological design
- Understandings about science and technology

Developing Student Abilities and Understanding

Students in grades 5-8 can begin to differentiate between science and technology, although the distinction is not easy to make early in this level. One basis for understanding the similarities, differences, and relationships between science and technology should be experiences with design and problem solving in which students can further develop some of the abilities introduced in grades K-4. The understanding of technology can be developed by tasks in which students have to design something and also be studying technological products and systems.

In the middle-school years, students' work with scientific investigations can be complemented by activities in which the purpose is to meet a human need, solve a human problem, or develop a product rather than to explore ideas about the natural world. The tasks chosen should involve the use of science concepts already familiar to students or should motivate them to learn new concepts needed to used or understand the technology. Students should also, through the experience of trying to meet a need in

the best possible way, begin to appreciate that technological design and problem solving involve many other factors besides the scientific issues.

[Work]...could be achieved by investigating simple, familiar objects through which students can develop powers of observation and analysis—for example, by comparing the various characteristics of competing consumer products, including cost, convenience, durability, and suitability for different modes of use. Regardless of the product used, students need to understand the science behind it. There should be a balance over the years with the products studied coming from the areas of clothing, food, structures, and simple, mechanical and electrical devices. The inclusion of some non-product-oriented problems is important to help students understand that technological solutions include the design of systems and can involve communication, ideas, and rules.

HISTORY AND NATURE OF SCIENCE (Selected)

Content Standard G: As a result of activities in grads 5-8, all students should develop understanding of

- Science as a human endeavor
- Nature of science
- History of science

Science as a Human Endeavor

- Science requires different abilities, depending on such factors as the field of study and type of inquiry. Science is very much a human endeavor, and the work of science relies on basic human qualities, such as reasoning, insight, energy, skill, and creativity—as well as on scientific habits of mind, such as intellectual honesty, tolerance of ambiguity, skepticism, and openness to new ideas.

Nature of Science

- Scientists formulate and test their explanations of nature using observation, experiments, and theoretical and mathematical models...
- In areas where active research is being pursued and in which there is not a great deal of experimental or observational evidence and understanding, it is normal for scientists to differ with one another about the interpretation of the evidence or theory being considered...
- It is part of scientific inquiry to evaluate the results of scientific investigations, experiments, observations, theoretical models, and the explanations proposed by other scientists.

History of Science

- Many individuals have contributed to the traditions of science. Studying some of these individuals provides further understanding of scientific inquiry, science as a

human endeavor, the nature of science, and the relationships between science and society.

- In historical perspective, science has been practices by different individuals in different cultures. In looking at the history of many people, one finds that scientists and engineers of high achievement are considered to be among the most valued contributors to their culture.
- Tracing the history of science can show how difficult it was for scientific innovators to break through the accepted ideas of their time to reach the conclusions that we currently take for granted.

History

I. National History Standards: Expansion and Reform (1801-1861) (Selected)

Standard 1: Students should understand United States territorial expansion between 1801 and 1861, and how it affected relations with external powers and Native Americans.

1A: Students should be able to demonstrate understanding of the international background and consequences of the Louisiana Purchase, War of 1812, and the Monroe Doctrine by:

9-12 Analyzing the consequences of the Louisiana Purchase for United States politics, economic development, and race relations, and describing its impact on Spanish and French inhabitants. [Explain historical continuity and change]

7-8 Illustrations: Draw upon evidence from the diaries of Lewis and Clark to construct a historical narrative assessing the importance of the newly acquired Louisiana Territory and analyze the effects of the expedition. *Why is it considered one of the most successful scientific expeditions in United States history? How did it contribute to friendly [?] relations with Native Americans in the region? What were its long-term effects?*

Construct a historical argument from the perspective of Native Americans on the impact of territorial expansion. *How did the acquisition of the Louisiana Territory affect Native Americans in the region?*

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